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THE RELATIVE EFFICIENCY OF SPAYED, OPEN, AND BRED HEIFERS IN THE FEED LOT

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THE RELATIVE EFFICIENCY OF SPAYED, OPEN, AND BRED HEIFERS IN THE FEED LOT^{1, 2}

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IN CATTLE-FEEDING OPERATIONS, opinions have differed on the relative efficiency of spayed, open, and bred heifers. Interest was stimulated by Cole's⁶ demonstration of superfecundity and superfertility in rats treated with mare gonadotropic hormone. Success was not attained with adult females so treated, although the average size of their litters was larger than in the normal colony. When young rats 21 to 31 days old were treated and bred, the number of implanted fetuses was extraordinary, reaching in one case 28. Among the 288 immature rats used in these experiments, 38 per cent of those sacrificed had more than 20 fetuses implanted, while the largest number of living young born was 17. The excessive pregnancy burden placed on these very young female rats was carried with an apparent increase in body growth.

Cole and Hart⁷ studied further the effect of pregnancy and lactation on growth in the rat. According to their data, pregnancy stimulates skeletal and tissue growth in this species beyond that found in nonbred littermate controls. This occurred even during the first pregnancy in females precociously matured by the injection of mare gonadotropic hormone. These enhanced gains continued at a fairly constant rate for the first six pregnancies. Nursing litters of four to six young did not retard the rate of gain over the nonbred controls.

The increased growth rate of these immature animals during pregnancy was accompanied by and dependent upon an increased food consumption, which was evident by the second day after conception. In continuing similar studies on pseudopregnant rats, Hart and Cole⁸ found

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⁶ Cole, H. H. Superfecundity in rats treated with mare gonadotropic hormone. *Amer. Jour. Physiol.* 119:704-12. 1937.

⁷ Cole, H. H., and G. H. Hart. The effect of pregnancy and lactation on growth in the rat. *Amer. Jour. Physiol.* 123:589-97. 1938.

⁸ Hart, G. H., and H. H. Cole. Studies on the cause of increased growth during pregnancy. *Soc. Exp. Biol. and Med. Proc.* 41:310-13. 1939.

that the gains caused by repeated pseudopregnancies were at nearly the same rate as secured in animals going through normal pregnancy.

The long-established practice of spaying heifers has been gradually declining. Breeding heifers to prevent the disturbance in feed lots incident to heat periods has become widely practiced. Ostertag⁹ at Stuttgart, Germany, reported experiments showing that bulls up to two years of age produced meat more efficiently than castrates of the same breed.

Gramlich¹⁰ and Gramlich and Thalman¹¹ reported data on spaying, sex, and age as factors in cattle feeding. They concluded that heifers made the most desirable beef carcasses at 8 to 15 months of age and that if the animals were marketed at these earlier ages there was little occasion for spaying. In three direct comparisons with spayed and open heifers, two with yearlings and one with calves, the average daily gain was 2 pounds for the open against 1.8 pounds for the spayed. The food required for 100 pounds of gain was 10 per cent greater for the spayed groups. There was also a difference in the dressing percentages—59.1 per cent for the open against 57.3 per cent for the spayed groups. The conclusion was reached that spaying, while not highly important for the feeder, may still be of some value to the ranchman, in managing his herd, by preventing pregnancy in heifers that are to be sold for slaughter.

The desire to obtain further data on the questions discussed in the foregoing paragraphs, particularly in relation to feed-lot operations, resulted in the experiments discussed in this paper. Over a period of years, about one fourth to one half of the heifers are required for replacement, and the remainder are available for slaughter.

THE 1938 FEEDING TRIAL

It was planned to carry concurrently in the feed lot, spayed, open, and bred heifer groups. Despite some difficulty in locating open heifers in the fall, when the animals were purchased, 37 head of yearlings were obtained in October, 1938. Most of these originated in northern Arizona as calves; the others were natives. The purchase weight after a 3 per cent shrink averaged 571 pounds per head. At purchase the heifers were on wheat stubble containing little or no grain; and their food supply

⁹ Ostertag, R. von. Veterinary science in relation to public health with special reference to the production and distribution of meat. Reports for the General Meetings, 11th Internatl. Vet. Congress, London 2:257-72. 1930.

¹⁰ Gramlich, H. J. The effect of spaying in beef production. Amer. Soc. Anim. Prod. Proc. 1926-27:213-16.

¹¹ Gramlich, H. J., and R. R. Thalman. Sex and age as factors in cattle feeding. Nebraska Agr. Exp. Sta. Bul. 252:1-55. 1930.

was probably lacking certain dietary essentials, notably vitamin A, protein, and total energy intake. They had been losing weight and were very thin on arrival at the University Farm on October 15, 1938. As a group they received 300 to 400 pounds of chopped barley straw containing 30 per cent molasses with alfalfa hay. They did not eat well on arrival and lost additional weight. A tuberculin test was given; and at the time of reading the test on October 20, they were weighed individually and divided according to weight and grade as follows:

Lot 1: To be bred; 13 head (5 good, 4 low good, and 4 medium); average weight, 537 pounds.

Lot 2: To remain open; 11 head (4 good, 4 low good, and 3 medium); average weight, 540 pounds.

Lot 3: To be spayed; 13 head (6 good, 3 low good, and 4 medium) average weight, 536 pounds.

At this time they were also numerically branded, with a caustic branding fluid, for identification. One animal was removed because rectal examination showed her to be pregnant.

The following day, October 21, the cattle were started on the preliminary feeding period. The straw was omitted, and they were gradually brought on feed by increasing the percentage of concentrates. At the end of the 24-day preliminary period they were averaging 14 pounds daily of a combination containing 60 per cent of alfalfa molasses meal and 40 per cent of concentrate mixture. The alfalfa meal contained 25 per cent of molasses; and the concentrate mixture consisted of 50 per cent of rolled barley, 40 per cent of dried molasses beet pulp and 10 per cent of hot pressed cottonseed meal. The changes in proportion of alfalfa molasses meal and the concentrate mixture during the 118-day experimental period are shown in table 3. The first alfalfa available was prepared on the University Farm. It was coarsely chopped into about 1-inch lengths and mixed with molasses. On January 25 a new source of this part of the ration became necessary, which consisted of much finer-chopped alfalfa molasses meal, passed through a hammer mill with a $\frac{1}{4}$ -in.-mesh screen.

The lot-3 animals were spayed on October 25. All recovered in normal time and were gaining weight at the end of the preliminary period.

The animals tentatively placed in lots 1 and 2 were carefully paired with respect to grade and weight in order to breed whichever one of a pair that came into estrum first. This arrangement resulted in getting the required number of animals for lot 1 pregnant in the shortest time.

Breeding began on November 1, and all animals for lot 1 became preg-

nant except no. 24. This heifer did not again manifest heat after the first breeding on November 28 and her nonpregnant condition was not ascertained until time of slaughter. Table 1 gives the weight of the uterus with contents, and the weight and crown-rump length of the fetus of each animal at the varying stages of gestation.

During the preliminary period four heifers in each lot were trained to be enclosed in individual pens at feeding time. The remainder of the animals in each lot were fed as a group. Individual feeding was planned in order to more accurately record the time of increase in appetite of

TABLE 1
BREEDING AND PREGNANCY DATA OF LOT-1 ANIMALS, 1938 TRIAL*

Animal no.	Date bred	Date rebred	Days pregnant	Weight of uterus and contents, pounds	Weight of fetus, pounds	Crown-rump length of fetus, centimeters
5.....	Nov. 12	None	131	17.3	2.7	28.5
8.....	Nov. 7	None	136	17.8	3.7	32.0
9.....	Nov. 1	None	142	21.8	4.4	23.0
10.....	Jan. 17	Feb. 4	47	1.3	2.3
15.....	Nov. 2	None	141	20.3	3.6	33.0
16.....	Nov. 14	None	129	17.7	2.8	30.0
18.....	Nov. 14	Dec. 7	106	7.2	1.1	21.5
24.....	Nov. 28	None	Not pregnant	0.5
25.....	Nov. 11	None	132	16.0	2.7	29.0
28.....	Nov. 5	None	138	20.2	4.2	33.5
32.....	Dec. 4	None	109	8.0	1.0	21.5
34.....	Nov. 1	None	142	20.0	3.4	32.5
39.....	Nov. 2	None	141	13.9	2.1	25.5

* The animals were killed on March 23, 1938.

pregnant heifers compared with open and spayed, if this occurred. The concentrates and roughage were fed mixed in definite proportions and were the same for each lot. This procedure simplified feeding according to appetite, yet assured the same quality of feed for all animals.

Individual feeding of cattle has its complications, and this trial proved no exception. In lots 1 and 2 the animals fed individually gained on the average less per day, consumed less food, and required more feed per 100 pounds' gain, than the group-fed animals. In lot 3 there was practically no difference. Water was not provided in the individual pens, whereas animals in the group-fed lots frequently drank water during feeding.

The cattle were weighed on three successive days at the beginning of and on two successive days at the close of the experimental period; the averages of these weights were used as beginning and final weights. Table

TABLE 2
WEIGHTS AND GAINS OF INDIVIDUAL ANIMALS, IN POUNDS; 1938 TRIAL

Animal no.	Beginning weight	Final weight	Total gain	Average daily gain
Lot 1				
5*	577	733	156	1.32
8*	650	904	254	2.15
23*	528	688	160	1.35
39*	593	775	182	1.54
9	548	805	257	2.12
10	507	745	238	2.02
15	673	953	280	2.37
16	573	840	267	2.26
18	546	720	174	1.47
24	517	680	163	1.38
28	662	895	233	1.97
32	491	720	229	1.94
34	589	835	246	2.09
Average	573	791	218	1.85
Lot 2				
3*	563	750	187	1.58
12*	516	730	214	1.81
26*	569	725	156	1.32
40*	604	755	151	1.27
19	638	888	250	2.11
20	672	925	253	2.14
22	584	843	259	2.19
23	520	755	235	1.99
29	542	725	183	1.55
33	507	743	236	2.00
38	542	723	181	1.53
Average	569	778	209	1.77
Lot 3				
11*	511	715	204	1.73
13*	592	855	263	2.23
14*	567	795	228	1.93
27*	627	815	188	1.59
2	508	695	187	1.59
6	549	698	149	1.26
7	551	868	317	2.68
17	573	780	217	1.84
21	657	900	243	2.06
30	506	653	147	1.24
35	520	780	260	2.20
36	594	868	274	2.32
37	453	625	172	1.46
Average	554	773	219	1.86

* The individually fed animals are marked with an asterisk.

2 gives these weights, with total gain and average daily gain individually of the animals in all the lots. Table 3 shows the average weights for each 30 days and the entire 118 days, including average daily gain and ration

TABLE 3
WEIGHTS, DAILY GAINS, AND FEED CONSUMPTION, IN POUNDS, OF ALL LOTS
IN 1938 TRIAL

Feeding period	Average initial weight	Average final weight	Average daily gain	Average daily ration		Feed per 100 pounds gain		
				Alfalfa molasses meal	Concentrates	Alfalfa molasses meal	Concentrates	Total
Lot 1 (13 head)								
First 30 days.....	573	654	2.70	10.0	6.7	322	248	620
Second 30 days.....	654	704	1.64	12.0	8.0	734	490	1,224
Third 30 days.....	704	743	1.32	9.8	9.8	742	742	1,484
Last 28 days.....	743	792	1.72	9.0	10.0	531	587	1,118
Entire period (118 days)....	573	792	1.85	10.3	8.6	556	467	1,023
Group-fed (118 days).....	568	799	1.96	10.6	9.0	542	456	998
Individually fed (118 days)...	587	775	1.60	9.4	7.9	607	507	1,114
Lot 2 (11 head)								
First 30 days.....	569	648	2.65	10.0	6.7	379	253	632
Second 30 days.....	648	702	1.78	11.6	7.8	653	435	1,088
Third 30 days.....	702	738	1.21	9.7	9.7	801	801	1,602
Last 28 days.....	738	778	1.43	9.1	10.1	641	703	1,344
Entire period (118 days)....	569	778	1.77	10.0	8.6	572	482	1,054
Group-fed (118 days).....	572	800	1.93	10.7	9.0	554	470	1,024
Individually fed (118 days)...	563	740	1.49	9.2	7.7	618	519	1,137
Lot 3 (13 head)								
First 30 days.....	554	633	2.63	10.1	6.7	385	257	642
Second 30 days.....	633	692	1.96	12.3	8.1	627	418	1,045
Third 30 days.....	692	727	1.17	9.9	9.9	849	849	1,698
Last 28 days.....	727	773	1.62	9.4	10.3	578	639	1,217
Entire period (118 days)....	554	773	1.86	10.4	8.8	565	475	1,040
Group-fed (118 days).....	546	763	1.84	10.6	8.9	576	485	1,061
Individually fed (118 days)...	574	795	1.87	10.1	8.4	553	448	1,001

with the feed consumed per 100 pounds' gain. Corresponding data are given for the group-fed and the individually fed animals.

The animals were sold on March 14, 1939; but actual slaughter was delayed until March 23. Table 4 gives the data on individual live weight, the carcass weight, warm and cold, together with the dressing percentage figured on the cold-carcass weight.

TABLE 4
SLAUGHTER DATA, 1938 TRIAL

Animal no.	Final weight, pounds	Selling weight, pounds	Warm-carcass weight, pounds	Cold-carcass weight, pounds	Dressing percentage, cold
Lot 1					
5.....	733	703	436	421	59.9
8.....	904	867	483	465	53.6
9.....	805	773	455	439	56.8
10.....	745	715	418	404	56.5
15.....	953	914	523	504	55.1
16.....	840	806	463	447	55.4
18.....	720	691	401	388	56.1
24.....	680	653	388	376	57.6
25.....	688	660	400	387	58.6
28.....	895	859	508	486	56.6
32.....	720	691	405	389	56.3
34.....	835	802	452	445	55.5
39.....	775	744	460	443	59.5
Average.....	791	760	446	430	56.6
Lot 2					
3.....	750	720	434	417	57.9
12.....	730	701	403	388	55.3
19.....	888	852	502	483	56.7
20.....	925	888	525	507	57.1
22.....	843	809	480	464	57.3
23.....	755	725	406	392	54.1
26.....	725	696	426	403	57.9
29.....	725	696	419	403	57.9
33.....	743	713	412	399	56.0
38.....	723	694	400	387	55.8
40.....	755	725	458	442	60.9
Average.....	778	747	442	426	57.0
Lot 3					
2.....	695	667	403	392	58.8
6.....	698	670	410	396	59.1
7.....	868	883	463	445	53.4
11.....	715	686	404	390	56.8
13.....	855	821	473	456	55.5
14.....	795	763	450	432	56.6
17.....	780	749	463	442	59.0
21.....	900	864	516	494	57.2
27.....	815	782	479	465	59.5
30.....	653	626	360	350	55.9
35.....	780	749	429	411	54.9
36.....	868	833	474	454	54.5
37.....	625	600	366	356	59.3
Average.....	773	742	438	422	56.9

At the end of the trial the slaughter animals graded somewhat lower than the feeders, as follows:

Lot 1: 1 good, 4 low good, and 8 medium.

Lot 2: 2 good, 2 low good, and 7 medium.

Lot 3: 1 good, 5 low good, and 7 medium.

The carcass grades were comparable with those of the finished animals, although five were removed from the cooler before they had been graded.

THE 1939 FEEDING TRIAL

In 1939 the experiment was repeated, using 40 head of yearling heifers from a different source. These animals came from New Mexico as calves and had been on a Madera County range for about one year. The range was dry, and the animals were even thinner than those purchased the previous year, though of considerably better breeding. They arrived at the University Farm on August 12, 1939; as a group they were given, between arrival and August 15, 1,790 pounds of alfalfa hay and 160 pounds of concentrates.

As in the first experiment, each of the animals was branded. On August 13 and 15, when individual weights were taken, the average weight was 482 pounds. On the latter date the heifers were graded and divided into three lots as nearly equal as possible on the basis of both weight and grade, as follows:

Lot 1: To be bred; 14 animals (4 good, 6 low good, and 4 medium); average weight, 477 pounds.

Lot 2: To remain open; 13 animals (4 good, 4 low good, and 5 medium); average weight, 485 pounds.

Lot 3: To be spayed; 13 animals (3 good, 6 low good, and 4 medium); average weight, 484 pounds.

The lot-3 animals were spayed on August 19, and all recovered from the operation in normal time. Ten had a recently formed corpus luteum in one ovary, showing that they were having estrual periods, whereas the ovaries in the other three were inactive.

It was desired to have the animals in lot 1 as far advanced in pregnancy as possible at the time of slaughter. Breeding was therefore started at once, no. 1 being bred on August 23. This animal, like no. 24 in the 1938 trial, did not become pregnant to this service, never came in heat again, and her nonpregnant condition was ascertained at time of slaughter. Some difficulty was experienced in getting all the animals bred. They had been paired with animals in lot 2 for breeding, as in the previous year, but no exchange of animals was made. It was felt that the early appearance of estrum might be evidence of more thrifty condition

and thus give advantage to lot 1 if transfers were made. At the time of slaughter, 9 animals were pregnant 150 days or more; 4 varied from 75 to 125 days; and 1 was open (table 5). The average weight of the uteri and ovaries of the open heifers in lot 2 was 0.57 pound, whereas that of the uteri alone in the spayed heifers in lot 3 was 0.15 pound.

The same concentrate mixture was fed throughout the trial, made up as follows: rolled barley, 50 per cent; dried molasses beet pulp, 40 per cent; hot pressed cottonseed meal, 10 per cent. A good quality of baled alfalfa hay produced on the University Farm constituted the sole rough-

TABLE 5
BREEDING AND PREGNANCY DATA OF LOT-1 ANIMALS, 1939 TRIAL*

Animal no.	Date bred	Date rebred	Days pregnant	Weight of uterus and contents, pounds
1.....	Aug. 23	None	Not pregnant	0.5
5.....	Aug. 23	None	175	26.0
9.....	Sept. 17	None	150	25.0
12.....	Sept. 17	Dec. 1	75	2.5
19.....	Sept. 5	None	162	25.5
20.....	Aug. 25	None	173	28.5
21.....	Aug. 31	None	167	26.0
22.....	Sept. 17	Nov. 5	101	6.5
28.....	Aug. 31	None	167	22.0
29.....	Aug. 27	None	171	30.5
31.....	Sept. 2	None	165	23.0
33.....	Sept. 4	None	163	21.5
36.....	Sept. 17	Oct. 13	124	10.0
37.....	Sept. 17	Nov. 12	94	4.5

* The animals were killed on February 14, 1940.

age. This change was made because evidence from the previous year indicated that the very fine-chopped roughage might have influenced rumination and appetite. No animals were fed individually, because of difficulties encountered in this procedure the previous year. Throughout the trial, concentrates and roughage were fed separately. The latter was always in excess, the hay mangers being cleaned out at regular intervals to remove coarse stems of alfalfa and foreign material; and the weigh-back was recorded. The concentrates were increased very gradually, to avoid throwing the animals off feed. It was desired not to have the animals overfinished at the end of the trial, the length of which was fixed by the desire to have gestation well advanced. During the preliminary period the concentrates were gradually raised from 1 to 4 pounds per head daily. Bringing animals to full feed from dry range feed when they are very thin is necessarily slower than when they come from green pastures in reasonably good feeder condition.

TABLE 6
WEIGHTS AND GAINS OF INDIVIDUAL ANIMALS, IN POUNDS; 1939 TRIAL

Animal no.	Beginning weight	Final weight	Total gain	Average daily gain
Lot 1				
19.....	578	777	199	1.33
20.....	572	933	361	2.40
12.....	612	973	361	2.40
28.....	553	835	282	1.88
31.....	556	915	359	2.39
5.....	543	865	322	2.15
9.....	528	883	355	2.37
36.....	537	873	336	2.24
22.....	510	832	322	2.15
33.....	537	883	346	2.31
1.....	515	807	292	1.95
21.....	513	825	312	2.08
29.....	508	802	294	1.96
37.....	468	788	320	2.13
Average.....	538	857	319	2.12
Lot 2				
10.....	598	922	324	2.16
18.....	603	968	365	2.43
4.....	565	882	317	2.11
39.....	578	917	339	2.26
27.....	555	855	300	2.00
16.....	573	832	259	1.73
15.....	510	873	363	2.42
40.....	530	862	332	2.21
25.....	525	828	303	2.02
17.....	510	712	202	1.35
7.....	483	723	240	1.60
26.....	512	817	305	2.03
34.....	473	712	239	1.59
Average.....	540	839	299	1.99
Lot 3				
6.....	550	807	257	1.71
13.....	557	808	251	1.67
3.....	577	857	280	1.87
14.....	533	788	255	1.70
2.....	563	840	277	1.85
35.....	555	867	312	2.08
38.....	507	832	325	2.17
30.....	535	795	260	1.73
23.....	518	790	272	1.81
8.....	503	765	262	1.75
11.....	533	775	242	1.61
32.....	497	737	240	1.60
24.....	478	732	254	1.69
Average.....	531	800	269	1.79

On September 11, 12, and 13, the animals were weighed individually for average weights. The final period started on September 12 and continued for 150 days to February 9, 1940. At the beginning of the final period the animals in lot 1 averaged 538 pounds; lot 2, 540 pounds; and lot 3, 531 pounds. The slightly reduced average of the lot-3 animals at

TABLE 7
WEIGHTS, DAILY GAINS, AND FEED CONSUMPTION, IN POUNDS, OF ALL LOTS
IN 1939 TRIAL

Feeding period	Average initial weight	Average final weight	Average daily gain	Average daily ration		Feed per 100 pounds, gain		
				Alfalfa hay	Concentrates	Alfalfa hay	Concentrates	Total
Lot 1 (14 head)								
First 30 days.....	538	616	2.60	13.9	5.5	534	212	746
Second 30 days.....	616	663	1.60	13.5	7.6	860	486	1,346
Third 30 days.....	663	715	1.73	12.4	9.0	721	521	1,242
Fourth 30 days.....	715	794	2.63	10.4	10.9	395	416	812
Fifth 30 days.....	794	857	2.09	6.5	13.4	313	644	957
Entire period (150 days)....	538	857	2.12	11.4	9.3	535	438	973
Lot 2 (13 head)								
First 30 days.....	540	612	2.40	14.3	5.5	593	229	821
Second 30 days.....	612	672	1.99	14.2	7.6	712	383	1,095
Third 30 days.....	672	713	1.36	12.2	9.0	900	663	1,563
Fourth 30 days.....	713	771	1.94	9.8	10.9	503	565	1,069
Fifth 30 days.....	771	839	2.26	9.3	13.4	410	594	1,005
Entire period (150 days)....	540	839	1.99	12.0	9.3	600	467	1,067
Lot 3 (13 head)								
First 30 days.....	531	605	2.40	13.8	5.5	562	226	788
Second 30 days.....	605	656	1.71	13.1	7.6	767	447	1,214
Third 30 days.....	656	694	1.27	11.9	9.0	935	711	1,645
Fourth 30 days.....	694	743	1.64	9.6	10.9	584	667	1,251
Fifth 30 days.....	743	799	1.88	4.3	13.4	226	716	943
Entire period (150 days)....	531	800	1.79	10.5	9.3	588	521	1,109

this time was probably caused by the spaying operation. Table 6 gives the beginning and final weights, with total gain and average daily gain of the animals in all the lots. Table 7 gives the average weights and daily gains for each 30 days and for the entire 150 days of the animals in each lot, including the average daily ration and feed consumed per 100 pounds' gain.

The final period terminated February 9; and the animals were

TABLE 8
SLAUGHTER DATA, 1939 TRIAL

Animal no.	Final weight, pounds	Selling weight, pounds	Warm-car carcass weight, pounds	Cold-car carcass weight, pounds	Dressing percentage, cold
Lot 1					
1.....	807	775	517	500	64.53
5.....	865	830	520	500	60.21
9.....	883	848	484	467	55.09
12.....	973	934	582	565	60.48
19.....	777	746	459	443	59.38
20.....	933	896	555	539	60.17
21.....	825	792	484	468	59.09
22.....	832	799	502	487	60.97
28.....	835	802	503	486	60.62
29.....	802	770	472	455	59.09
31.....	915	878	534	517	58.85
33.....	883	848	497	481	56.74
36.....	873	838	516	500	59.66
37.....	788	756	470	455	60.14
Average.....	857	822	507	490	59.64
Lot 2					
4.....	882	847	538	522	61.64
7.....	723	694	446	432	62.24
10.....	922	885	538	520	58.74
15.....	873	838	536	522	62.28
16.....	832	799	492	477	59.72
17.....	712	684	441	426	62.32
18.....	968	929	605	585	62.95
25.....	828	795	515	500	62.90
26.....	817	784	496	481	61.32
27.....	855	821	501	482	58.72
34.....	712	684	430	416	60.86
39.....	917	880	553	536	60.88
40.....	862	828	523	506	61.14
Average.....	839	805	509	492	61.21
Lot 3					
2.....	840	806	506	493	61.13
3.....	857	823	499	482	59.55
6.....	807	775	494	479	61.82
8.....	765	734	470	456	62.09
11.....	775	744	468	452	60.75
13.....	808	776	476	462	59.56
14.....	788	756	482	469	61.99
23.....	790	758	457	441	59.20
24.....	732	703	439	425	60.47
30.....	795	763	470	457	59.87
32.....	737	708	441	425	61.19
35.....	867	832	510	493	60.19
38.....	832	799	488	473	60.22
Average.....	800	767	477	462	60.62

weighed individually on February 8, 9, and 10, to secure the average final weights. The selling weight was taken in the morning before feeding, and a 4 per cent shrink allowed. Each group was hauled by truck to a nearby slaughterhouse and killed on successive days—lot 3 on February 12, lot 2 on February 13, and lot 1 on February 14. Table 8 gives the final weight and slaughter data of the individual animals.

At the end of this second trial the slaughter animals were well finished and graded higher than the feeders, as follows:

Lot 1: 2 choice, 9 top good, 1 good, and 2 medium.

Lot 2: 4 choice, 4 top good, 2 good, 2 low good, and 1 medium.

Lot 3: 2 choice, 5 top good, 3 good, and 3 medium.

The carcass grades, which compared reasonably well with those of the finished animals, were as follows:

Lot 1: 4 choice, 4 top good, 3 good, and 3 medium.

Lot 2: 4 choice, 2 top good, 2 good, 1 low good, and 4 medium.

Lot 3: 2 choice, 5 top good, 3 good, and 3 medium.

DISCUSSION

Nonpregnant heifers, no. 24 in the first trial (1938) and no. 1 in the second trial (1939), are included in the averages of their respective groups. If they were removed from the calculations the average daily gain of lot 1 in the first trial would have been 1.88 pounds instead of 1.85 pounds and the average weight of the uteri 15.1 pounds instead of 14.0 pounds. In the second trial the daily gain with no. 1 omitted would have been 2.14 pounds in place of 2.12 pounds and the weight of the uteri 19.4 pounds instead of 18.0 pounds. It is evident therefore that inclusion of these two nonpregnant animals does not materially change the results and avoided the doubtful procedure of correcting feed consumption on the basis of the average consumption of the lots, had they been removed from the calculation.

The breeding of the animals in the 1938 trial was not such as to make the most desirable quality of feeders. They were rather fine-boned and light-muscled. They went on feed fairly well, but after the first 60 days the gains were unsatisfactory. According to some unpublished observations, animals as thin as these, especially those coming to the feed lot from dry ranges deficient in certain dietary essentials, must be brought to full feed slowly. During the third 30-day period, when gains were most unsatisfactory, the change from coarse to finely ground alfalfa was made. To judge from observations on the time, frequency, and duration of rumination at this period, the heifers were not ruminating so

much as would have been expected in animals on whole alfalfa hay. The marked fineness of the alfalfa meal fed from January 25 to the end of the feeding period probably caused or enhanced this condition. Appetite was capricious, and slight increases in feed resulted in lower intake with considerable weigh-back. Thus the feed required per 100 pounds' gain in the third 30-day period was very high, and the individual daily gains were low.

Parasitic infestation was also manifested at this time. With the change in the chopped alfalfa, some of the animals developed scours. Number 18 in lot 1 passed bloody feces for a week beginning January 27, and examination showed the cause to be infestation with coccidiosis. The feces of all the heifers were examined to determine the extent of this condition. Only a few animals were discharging coccidia, and no. 18 showed no further symptoms. Half of the animals showed slight infestation with the microscopic stomach worm *Trichostrongylus*. The extent to which these parasites affected gains and feed utilization cannot be determined. Infestation was, however, distributed through all the lots.

During the fourth 30-day period, feed intake and appearance indicated that the animals had attained about as much finish as economy and their quality justified. It was decided, therefore, to close the experiment although most of the animals had not attained more than medium slaughter condition. The slaughter data show no significant differences in the dressing percentages of the three lots.

In the 1939 trial the animals were never off feed, and the concentrate mixture was finally raised to 15 pounds per head daily. They made satisfactory gains, finished well, and produced carcasses of high quality. The lower rate of gain during the third 30-day period was perhaps caused by a rather heavy infestation of warbles that were emerging from the backs of the animals at this time, with accompanying local irritation and swelling. The pregnant lot was further advanced in pregnancy than in the previous year. This condition was desired in order to ascertain whether increased appetite and gains would be manifested by heifers more advanced in pregnancy than those of the 1938 trial.

The concentrates consumed by all the lots were constant, although more would have been supplied to any group if the feed would have been consumed. Toward the end of the 150 days and at the time of feed increases earlier in the trial, 3 hours or more were required for all the concentrates to be consumed, although the feed was always gone before the next feeding time arrived. To accomplish this result, hay consumption varied somewhat. A reduced quantity of fresh hay was placed in the mangers of any group when concentrates were slow in being cleaned

up. Excess hay, however, was always present in the mangers of all three groups.

For the 150-day period, hay consumption was greatest in lot 2, averaging 0.6 pound per animal daily over the amount consumed by the animals in lot 1, and 1.4 pounds more than in lot 3. These differences are not significant. The data confirm the findings of the previous year—namely, that pregnancy even in the more advanced stages does not increase appetite in cattle.

Hay, concentrates, and total feed consumption per 100 pounds' gain were lowest in lot 1. Concentrates and total feed per 100 pounds' gain were lower in lot 2 than in lot 3, the latter being definitely the highest, though hay consumption per 100 pounds' gain was slightly higher in lot 2 than in lot 3.

These data on live weights together with the accompanying higher average daily gain in the lot-1 animals, seemed to indicate somewhat better utilization of feed in the pregnant group. That there was no difference, however, in carcass gain or efficiency of feed utilization is shown in the following paragraph.

The average weight of the pregnant uteri of lot-1 animals in the first trial was 14 pounds (table 1) and in the second trial 18 pounds (table 5). This constitutes approximately the difference in the average live weight of the animals at the end of the trials. The carcass weights of the lot-1 and lot-2 animals in each trial were about equal. The difference in live weight and apparent gains is therefore due to the weight of the gravid uteri. As the weight of the gravid uteri including the amniotic fluid, even in animals advanced as far as 175 days in pregnancy, is very largely made up of water, the extra weight of the pregnant animals on the same amount of feed is thereby explained. If the live-weight gain is corrected for the uterus and its contents, then the feed required for 100 pounds' gain in lot 1 becomes practically the same as for lots 2 and 3, in both trials. In the second trial the difference in daily gain between lot 2 (open) and lot 3 (spayed) approached statistical significance. In the first trial, however, the gains were similar and when both trials are considered there are no statistically significant differences between any of the lots.

The dressing percentage (calculated as in the first trial from the selling weight and the cold weight as the carcasses were sold from the cooler after hanging 7 to 14 days) was 59.64 per cent for lot 1, 61.21 per cent for lot 2, and 60.62 per cent for lot 3.

The pregnant uteri and ovaries of lot 1, including the one open animal, averaged 18.0 pounds against 0.57 pound for those of lot 2 and 0.15

pound for the lot-3 animals. This slight difference in dressing percentage of the three groups, compared with the considerable difference in weight of the uteri and ovaries, substantiates similar data of the previous year. Here, then, is evidence that, in well-finished heifers, advanced pregnancy (150 to 175 days) does not reduce the dressing percentage materially.

Animals advanced in pregnancy show mammary gland development when a cross section is made of the udder. When pregnancy extends beyond the fifth month, a soft place is present over the milk cistern at the base of the teat. Leakage of secretion commonly extends down the carcass for a distance of 6 to 18 inches after 24 hours in the cooler, and this fact is used as a trading argument against the desirability of such carcasses. On open and spayed heifers no mammary development is noticeable on cross section of the udder, which appears to be a solid mass of fat.

It is interesting that the only open heifer in lot 1 had the highest dressing percentage of the entire 40 animals, being 1.58 per cent higher than its nearest competitor, animal 18 in lot 2 with 62.95 per cent. This heifer was bred early and never came in heat again, though a bull was placed in the corral every afternoon until January 15. On the other hand, a very similar case, no. 24 of the pregnant lot the previous year, showed no such advantage in dressing percentage.

The activity of unbred heifers in riding each other at estrual periods is particularly noticeable in the early stages of feeding in dry lot, no doubt because of the stimulating action of high food intake. As fattening progresses, this behavior becomes less marked; and toward the end of the feeding period the only evidence of a heifer's being in heat may be her failure, at times, to step up to the feed bunk with the other animals in the pen.

CONCLUSIONS

The data from these two feeding trials confirm those from other sources: no advantage accrues from spaying heifers that are going into the feed lot.

Activity of open heifers in riding each other at estrual periods is not serious. It becomes reduced as finish approaches and is not involved in feed consumed or in cost per hundred pounds of gain.

Pregnancy in cattle does not cause increased appetite or food consumption. Neither does its existence up to the fifth or sixth month seriously affect the dressing percentage in reasonably well-finished heifers. The slight increase in weight of pregnant over open animals is due to the increase in weight of the gravid uterus. This consists largely

of water, and the change can thus take place without significant differences in food intake.

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